CLAIMS

1. An image compression device, comprising:

an encoding part that performs a frequency analysis of image data, encodes a plurality of coefficients generated by the frequency analysis first unit by first unit, and generates a plurality of codes;

a code reduction part that reduces the amount of the codes of each of the first units; and

a processing part that further divides the coefficients or the codes in each of the first units into a plurality of second units, and increases the amount of code reduction in the code reduction part for each of the second units according to values of the coefficients of each of the second units or according to values of the codes of each of the second units.

2. The image compression device as claimed in claim 1, wherein:

the code reduction part comprises:

a truncation table including a plurality of truncation data sets to each of which a data number is assigned, said truncation data sets determining the amount of the codes to be truncated from the codes corresponding to one of the coefficients from the least

significant bit of the codes in each of the first units, said truncation data sets being arranged so that along with an increase of the data number, the amount of the codes to be truncated increases or decreases gradually, and the image quality degrades or improves gradually; and

a rate controller that determines one of the data numbers corresponding to one of the truncation data sets, said one of the truncation data sets resulting in a change of the amount of the codes of each of the first units after code truncation in accordance with the one of the truncation data sets to be close to a target value.

3. The image compression device as claimed in claim 1, performing coding in compliance with the JPEG 2000 standards, wherein:

the encoding part performs a two-dimensional discrete wavelet transformation on the image data and generates a plurality of wavelet coefficients, divides the wavelet coefficients into a plurality of sub-bands, performs arithmetic coding for the wavelet coefficients of each of the sub-bands and generates a plurality of codes;

the code reduction part reduces the amount of the codes by truncating a portion of the codes corresponding to one of the wavelet coefficients from the

least significant bit of the codes in each of the sub-bands; and

the processing part divides each of the sub-bands into a plurality of code blocks, and increases the amount of codes to be truncated in the code reduction part for each of the code blocks according to values of the wavelet coefficients in each of the code blocks or according to values of data obtained by processing the wavelet coefficients of each of the code blocks.

4. The image compression device as claimed in claim 3, wherein:

the processing part comprises:

an average value calculation circuit that calculates an average value of the wavelet coefficients of a plurality of effective pixels in each of the code blocks, or an average value of the data obtained by processing the wavelet coefficients of the effective pixels in each of the code blocks; and

a masking coefficient calculation circuit that determines the increase of the amount of the codes to be truncated in each of the code blocks performed in the code reduction part according to the average value obtained in the average value calculation circuit.

5. The image compression device as claimed in claim 4, wherein:

the average value calculation circuit quantizes the wavelet coefficients of the effective pixels in each of the code blocks, and calculates the average value of the data obtained by quantizing the wavelet coefficients.

6. The image compression device as claimed in claim 4, wherein:

the average value calculation circuit encodes the wavelet coefficients of the effective pixels in each of the code blocks by the arithmetic coding, and calculates the average value of the data obtained by encoding the wavelet coefficients.

7. An image compression method, comprising:

a first step of performing a frequency analysis on image data, encoding a plurality of coefficients obtained by the frequency analysis first unit by first unit, and generating a plurality of codes;

a second step of reducing the amount of the codes of each of the first units; and

a third step of further dividing the coefficients or the codes of each of the first units into

a plurality of second units, and increasing the amount of code reduction for each of the second units according to values of the coefficients of each of the second units or according to values of the codes of each of the second units.

8. The image compression method as claimed in claim 7, wherein:

the second step comprises:

a step of creating a truncation table including a plurality of truncation data sets to each of which a data number is assigned; said truncation data sets determining the amount of the codes to be truncated from the codes corresponding to one of the coefficients from the least significant bit of the codes in each of the first units, said truncation data sets being arranged so that along with an increase of the data number, the amount of the codes to be truncated increases or decreases gradually, and the image quality degrades or improves gradually; and

a step of determining one of the data numbers corresponding to one of the truncation data sets, said one of the truncation data sets resulting in a change of the amount of the codes of each of the first units after code truncation in accordance with the one of the

truncation data sets to be close to a target value.

9. The image compression method as claimed in claim 7, performing coding in compliance with the JPEG 2000 standards, wherein:

the first step comprises a step of performing a two-dimensional discrete wavelet transformation on the image data and generating a plurality of wavelet coefficients, dividing the wavelet coefficients into a plurality of sub-bands, performing arithmetic coding for the wavelet coefficients of each of the sub-bands and generating a plurality of codes;

the second step comprises a step of reducing the amount of the codes by truncating a portion of the codes corresponding to one of the wavelet coefficients from the least significant bit of the codes in each of the sub-bands; and

the third step comprises a step of dividing each of the sub-bands into a plurality of code blocks, and increasing the amount of codes to be truncated in the code reduction part for each of the code blocks according to values of the wavelet coefficients in each of the code blocks or according to values of data obtained by processing the wavelet coefficients of each of the code blocks.

10. The image compression method as claimed in claim 9, wherein:

the third step comprises:

a fourth step of calculating an average value of the wavelet coefficients of a plurality of effective pixels in each of the code blocks, or an average value of the data obtained by processing the wavelet coefficients of the effective pixels in each of the code blocks; and

a fifth step of determining the increase of the amount of the codes to be truncated in each of the code blocks performed in the code reduction part according to the average value obtained in the average value calculation circuit.

11. The image compression method as claimed in claim 10, wherein:

the fourth step comprises a step of quantizing the wavelet coefficients of the effective pixels in each of the code blocks, and calculating the average value of the data obtained by quantizing the wavelet coefficients.

12. The image compression method as claimed in claim 10, wherein:

the fourth step comprises a step of encoding the wavelet coefficients of the effective pixels in each

of the code blocks by the arithmetic coding, and calculating the average value of the data obtained by encoding the wavelet coefficients.

13. A program for compressing image data, comprising instructions for causing a computer to execute:

a first step of performing a frequency analysis on the image data, encoding a plurality of coefficients obtained by the frequency analysis first unit by first unit, and generating a plurality of codes;

a second step of reducing the amount of the codes of each of the first units; and

a third step of further dividing the coefficients or the codes of each of the first units into a plurality of second units, and increasing the amount of code reduction for each of the second units according to values of the coefficients of each of the second units or according to values of the codes of each of the second units.

14. The program as claimed in claim 13, wherein:

the second step comprises:

a step of creating a truncation table

including a plurality of truncation data sets to each of which a data number is assigned, said truncation data sets determining the amount of the codes to be truncated from the codes corresponding to one of the coefficients from the least significant bit of the codes in each of the first units, said truncation data sets being arranged so that along with an increase of the data number, the amount of the codes to be truncated increases or decreases gradually, and the image quality degrades or improves gradually; and

a step of determining one of the data numbers corresponding to one of the truncation data sets, said one of the truncation data sets resulting in a change of the amount of the codes of each of the first units after code truncation in accordance with the one of the truncation data sets to be close to a target value.

15. The program as claimed in claim 13, said program performing image compression in compliance with the JPEG 2000 standards, wherein:

the first step comprises a step of performing a two-dimensional discrete wavelet transformation on the image data and generating a plurality of wavelet coefficients, dividing the wavelet coefficients into a plurality of sub-bands, performing arithmetic coding for

the wavelet coefficients of each of the sub-bands and generating a plurality of codes;

the second step comprises a step of reducing the amount of the codes by truncating a portion of the codes corresponding to one of the wavelet coefficients from the least significant bit of the codes in each of the sub-bands; and

the third step comprises a step of dividing each of the sub-bands into a plurality of code blocks, and increasing the amount of codes to be truncated in the code reduction part for each of the code blocks according to values of the wavelet coefficients in each of the code blocks or according to values of data obtained by processing the wavelet coefficients of each of the code blocks.

16. The program as claimed in claim 15, wherein:

the third step comprises:

a fourth step of calculating an average value of the wavelet coefficients of a plurality of effective pixels in each of the code blocks, or an average value of the data obtained by processing the wavelet coefficients of the effective pixels in each of the code blocks; and

a fifth step of determining the increase of

the amount of the codes to be truncated in each of the code blocks performed in the code reduction part according to the average value obtained in the average value calculation circuit.

17. The program as claimed in claim 16, wherein:

the fourth step comprises a step of quantizing the wavelet coefficients of the effective pixels in each of the code blocks, and calculating the average value of the data obtained by quantizing the wavelet coefficients.

18. The program as claimed in claim 16, wherein:

the fourth step further comprises a step of encoding the wavelet coefficients of the effective pixels in each of the code blocks by the arithmetic coding, and calculating the average value of the data obtained by encoding the wavelet coefficients.

19. A storage medium that stores a program for compressing image data and comprising instructions for causing a computer to execute:

a first step of performing a frequency analysis on the image data, encoding a plurality of

coefficients obtained by the frequency analysis first unit by first unit, and generating a plurality of codes;

a second step of reducing the amount of the codes of each of the first units; and

a third step of further dividing the coefficients or the codes of each of the first units into a plurality of second units, and increasing the amount of code reduction for each of the second units according to values of the coefficients of each of the second units or according to values of the codes of each of the second units.

20. The storage medium as claimed in claim 19, wherein:

in said program,

the second step comprises:

a step of creating a truncation table including a plurality of truncation data sets to each of which a data number is assigned, said truncation data sets determining the amount of the codes to be truncated from the codes corresponding to one of the coefficients from the least significant bit of the codes in each of the first units, said truncation data sets being arranged so that along with an increase of the data number, the amount of the codes to be truncated increases or

decreases gradually, and the image quality degrades or improves gradually; and

a step of determining one of the data numbers corresponding to one of the truncation data sets, said one of the truncation data sets resulting in a change of the amount of the codes of each of the first units after code truncation in accordance with the one of the truncation data sets to be close to a target value.

21. The storage medium as claimed in claim 19, wherein:

the image compression is performed in compliance with the JPEG 2000 standards, wherein:

the first step comprises a step of performing a two-dimensional discrete wavelet transformation on the image data and generating a plurality of wavelet coefficients, dividing the wavelet coefficients into a plurality of sub-bands, performing arithmetic coding for the wavelet coefficients of each of the sub-bands and generating a plurality of codes;

the second step comprises a step of reducing the amount of the codes by truncating a portion of the codes corresponding to one of the wavelet coefficients from the least significant bit of the codes in each of the sub-bands; and

the third step comprises a step of dividing each of the sub-bands into a plurality of code blocks, and increasing the amount of codes to be truncated in the code reduction part for each of the code blocks according to values of the wavelet coefficients in each of the code blocks or according to values of data obtained by processing the wavelet coefficients of each of the code blocks.

22. The storage medium as claimed in claim 21, wherein:

in said program:

the third step comprises:

a fourth step of calculating an average value of the wavelet coefficients of a plurality of effective pixels in each of the code blocks, or an average value of the data obtained by processing the wavelet coefficients of the effective pixels in each of the code blocks; and

a fifth step of determining the increase of the amount of the codes to be truncated in each of the code blocks performed in the code reduction part according to the average value obtained in the average value calculation circuit.

23. The storage medium as claimed in claim 22,

wherein:

in said program:

the fourth step comprises a step of quantizing the wavelet coefficients of the effective pixels in each of the code blocks, and calculating the average value of the data obtained by quantizing the wavelet coefficients.

24. The storage medium as claimed in claim 16, wherein:

in said program:

the fourth step further comprises a step of encoding the wavelet coefficients of the effective pixels in each of the code blocks by the arithmetic coding, and calculating the average value of the data obtained by encoding the wavelet coefficients.